TECHNICAL FIELD

The invention relates to a method and a protection system for hindering the progress of avalanches that fall with high velocity and contain an enormous amount of energy, particularly those heading towards inhabited districts, constructions and other things, that need to be protected.

The method consists mainly in catching the avalanche in the special Avalanche Protection System (APS), where the protection system is planted on a mountain slope, in a canyon, at the foot of a mountain or at other places where the risk of falling avalanches exists and can be put up in overlapping rows to form a continuous protective wall against a potential avalanche.

BACKGROUND ART

Up until now, many methods of hindering avalanches have been used, but with various results. Racks and cones have been raised, ditches and defense walls have been built, but these protection systems have not been completely effective: Racks have been swept away, avalanches have swept over the cones; embankments and ditches require a lot of land and can be dangerous. Embankments are also still at an experimental stage. Estimates show that the first avalanche to fall on a defense wall will almost fill up the slope in front of the wall putting at risk the village or town that the wall is supposed to protect in the event of a secondary avalanche falling over the first one. In addition, the building of a defense wall or ditches can greatly damage the land, not to mention the view. Building a defense wall is also costly and time-consuming.

DISCLOSURE OF THE INVENTION

The goal of this new invention is to set up an APS that is simple, safe, successful and, not least, barely visible. It is superior to the other systems in that is does not destroy the view or the land and it can easily be erected high up in the mountains or in canyons where it is hard to build walls and dig ditches. It is easy to put up, and equally easy to dismantle for inspections, summer storage or maintenance.

This goal is achieved using a new and unique method, as disclosed in patent claim 1: Where method mainly consists in catching the avalanche in a special protection system,

which mainly consists of a net sack fastened by main strings to the ground, and an oblong storage box consisting of a storage platform, that stands on poles, and a protection helmet, where the net sack is ready and waiting inside the storage box, wheras the protection system is planted on a mountain slope, in a canyon, at the foot of a mountain or at other places where the risk of falling avalanches exists, in such a way that one of the long side of the storage box faces the direction from which the avalanche falls and the air mass, that the avalanche thrusts ahead of itself as it falls, flings the protection helmet backwards away from the platform, and where by the net sack opens because of the wing units and the net sack then flings out of the storage box, where the wings helps to keep net sack open because of the effect from the air stream, the form of the wings and their placement below and sideways of the opening of the net sack.

The avalanche is captured in a net sack and the power of the snowfall is converted into energy which in turn helps to melt the snow. The net lets air and snow partly through it but stops the rest of the snow. As this happens, some of the energy from the avalanche is transferred into heat. This heat is conducted along main strings and in the process is dissipated, partly by melting the ice crystals that are forced through the APS and partly by cooling down the APS which heats up through friction with and pressure from the snow. The heat and energy are thus transferred from the avalanche through the main strings into anchors in the earth. This happens while the avalanche is being stopped.

The goal is also achieved by that the unique method requires new and unique protection system equipment as disclosed by patent claim 4: The protection device consisting mainly of a semi-circular net sack with mesh and an opening; a top rope; a foot rope; leading strings and wing units attached to the top rope and the net sack; main strings which are fastened to ground anchores at one end and at the other end to leading strings, foot rope and the top rope of the net sack; flat plates that are attached to the main strings; storage platform standing on poles which are equipped with locking hinges; and a protective helmet.

While existing methods such as ditches and embankments require the intensive and long-term use of heavy machinery, the APS is easy to assemble and erect and does not violate the environment or spoil the view. The only disruptive part of the construction of

the APS is when the earth anchors are concreted into the ground. After APS has been installed once, it can be used repeatedly, even though an avalanche falls on the system and perhaps even damages it somewhere. In the event that this happens, then an emergency system can be hooked to the same earth anchors and placed on top of the first system.

Further useful embodiments and advantages of the invention are disclosed in the dependent claims 2 – 3 and 5 – 8.

BREIF DESCRIPTION OF DRAWINGS

The invention is described in more detail in the following part with references to the explanatory figures where:

Figure 1 - Shows the entire protection system, set up and ready to halt the avalanche. Shown from the front and above in 3D

Figure 2 - Shows the entire protection system. Set up and ready. Shown from behind and above in 3D.

Figure 3 - Shows the entire protection system, set up and ready, from behind and from a diagnoal perspective.

Figure 4 - Shows the APS packed away, ready for use, in its storage box, shown from behind and diagonally in 3D.

Figure 5 - Shows cross section of the storage box with the APS in it. Cross-section A-A figure nr. 7.

Figure 6 - Shows longitudinal section of the storage box including the APS

Figure 7 - Shows the APS in its storage box, not in use, from above.

MODES FOR CARRYING OUT THE INVENTION

The APS technique consists of capturing an avalanche in a special protection device that is stored, ready to spring into action, in an oblong storage box (16). It is erected wherever the risk of an avalanche exists. It dissipates the power of the avalanche by conducting the energy generated by the avalanche along main strings (3,11) into anchors and ending in the ground (2). In addition, by converting to heat the energy is partly disintegrated from the avalanche. The heat develops when the air and the mass of

snow gathers in the net sack (9) with a grate speed. When the ice crystal compress through the toils, they melt. In this way the APS stops the avalanche while simultaneously reducing its energy.

The number of APS (1) units required varies from one to many. They can be set up in overlapping rows to form a continuous protective wall, a second row being placed behind the spaces that inevitably develop in the first row when the units are placed side by side. This increases the effectiveness of the APS and ensures that the avalanche is stopped before it can inflict any damage. The APS units are stored in their storage boxes and are released at the moment that the avalanche begins to cascade towards them, at which point, the net and all the other various parts of the invention are released.

In figures 1-3, the APS is shown in its extended position, as if it has already been released and an avalanche has entered it. One of the main components of APS is the semi-circular-net sack (9), which has a square looking opening to contain the snow as it crashes down. This opening is formed by strong main strings along the top (13) and bottom (10) of the net and side leading strings which run along both sides (12). The size of the opening is adjustable to cope with the environmental conditions present. The net sack is fastened to strong main strings, which form this square or box looking opening: there is a top rope (13), side leading strings (12) on both sides and a base rope (10). The net sack (9) consists of 3 pieces of net woven together to form the top, bottom, and back. There are 2 main leading strings (14 and 15) which run from the corners of the front opening around the back of the net giving the net its shape. The net sack is a strong plastic weave that forms net toils, the density of which is around 30-90%. This density can be adapted to suit different situations and locations.

Attached to the top rope of the bag (9) and the top of the bag itself is a wing unit (7) that is similar in shape to an airplane wing. This wing unit consists of smaller units which are fastened to each other with pliable attachments so that the bag's upper edge is slightly flexible and can adjust, to some extent, to the flood of snow. As an avalanche falls, it generates a terrific wind that it pushes in front of it. As the wind hits the APS, the wing unit lifts the topline (13) ensuring that the net sack (9) opens to receive the snow. This essential for the APS to function as it should.

The second main feature of the APS is the main strings (3 and 11) that hold and connect the net sack (9) to the ground anchors (2) that in some way bored into the ground and concreted into place. As the avalanche falls into the bag, the side main strings (3) transfer some of the energy from the avalanche away from the bag and into the ground anchors. The main strings are made of strong steel or fiber, which is an extremely strong material.

Altogether there are four main strings (3), two on each side, which run from the ground anchors (2) to the four corners of the net sack (9) where they meet the side leading strings (12). A panel (8) is strung sideways along each pair of main strings (3). As the main strings run from the earth anchors, they meet the flat panels on their inside edge at the top and bottom front corners (see figures 1-3). The main strings run along the panels and leave them from the outside edge, continuing to the corners of the net sack (9). This causes the front end of the panels to splay out slightly when the APS is completely released, as is shown in figures 1-3. When the avalanche hits the APS the main strings tauten, keeping the sides of the bag extended and funneling the snow into the bag.

There are additional and more numerous main strings (11) which run from the base rope (10) running along the bottom edge of the bag (9) to earth anchors positioned some way in front of the bag (2).. These main strings (11) are evenly spaced and the number of them can be adjusted depending on the desired size of the opening. As they near the earth anchors (2) the main strings converge and are bound together before splitting again and continuing on to their individual anchors (see figure 1). As with the side main strings (3), the main purpose of these lower main strings (11) is to connect the net sack to the earth anchors and to channel the energy from the avalanche to the earth. An additional function of these lower main strings (11) along with the storage box (5), is to hold the base rope (10) in place and the lower edge of the bag close to the ground, so that it collects the snow.

There are at least three sets of earth anchors on the APS, each of them consisting of 1-12 separate anchors (2). As the main strings approach the mountainside they converge

and are fastened together. From this fastening point, strong wires run out in a fan pattern, like tentacles, connecting the main strings (3, 11) to the earth anchors and distributing the force of the avalanche. The anchors (2) are steel poles that have been drilled and concreted into the mountain rock. They are made of strong steel or other strong and durable material

Figure 4 shows how the APS (1) looks when put away in the storage box (16). It lies across the side of the mountain ready to catch the first avalanche that falls on it.

The storage box (16) is a collapsible long, narrow box. Its main component is a storage platform which forms its base (5). It stands on hinged poles (4) and is covered with a light protective helmet (17) that forms the top of the box. The sides of the box are the panels(8) which keep the main strings taut when the APS is released, as previously described.

In the box, folded and ready to use, are the net sack (9) the leading strings and as much of the leading strings (10, 12, 13, 14, 15) as possible, as well as the wing units (7) which rest on top, just under the helmet. The storage box (16) protects the APS from extreme weather conditions such as icing and sunlight. In this manner, the APS should last at least decades if not hundreds of years.

The protective helmet (17) is made of plastic or other light and serviceable material and is lightly fastened to the platform (5) so it can disengage easily when the avalanche smashes on to the storage box (16). This allows the APS (1) to expand unrestrained to capture and stop the avalanche.

Like the wing units along the upper edge of the net, the platform (5) is shaped like an n airplane wing that is upside-down. It stands on at least six poles (4) that are fastened to the ground rock with concrete. There are diagonal reinforcements or sidebars, between the poles, as is shown in figures 4 and 5, to prevent it from skewing to the side. The poles (4) have at least two hinges (6). The hinges will be equipped with a locking bolt, which make the poles stay erect in the storage position. Not all of the hinges have locking bolts it depends on the placement of the APS. When a certain amount of force

is applied to the poles, by the avalanche the bolts break in half to allow the poles to hinge and the APS to unfold. This pressure forces the storage platform (5) to fall backwards and down onto the lower main strings (11), holding the main strings securely in place. These in turn hold the base rope (10) down, ensuring that the net sack (9) opens at the bottom. In this position, the storage platform (5) also works as a spoiler directing the flow of the air and snow into the bag. The poles (4) with hinges (6) and their ground fastenings guarantee that the platform remains in this position while the avalanche rushes over it and into the bag.

The length of the poles (4) vary and is determined by the situation and depth of snow layers in each location, so that the platform (5) will always be above the snow in the location where the highest number of snow layers has been measured.

The poles and platform are made of acid protected steel, plastic or another strong and durable material that can survive long-term bad weather and sunlight.

In brief, the APS works as follows: The main part of the APS (1) is folded together, stored but ready to use in a protective box (16) waiting for an avalanche or the cold wind that an avalanche generates ahead of itself, to smash onto the box. As it hits the box, the box collapses: the helmet (17) breaks or flies off the storage platform (5) allowing the APS to open. The power from the strong airflow thrusts the net sack (9) backwards away from the platform and forces it open. Simultaneously, the wings (7) lift up the upper edge. The panels (8) on the lateral main strings (3) are forced to the side. The hinges (6) on the poles (4) fold, allowing he storage platform which forms the base of the storage box (5) to fall backwards onto the main strings (11), holding the baserope (10) and the lower edge of the bag down, as has been previously described. This guarantees that net sack (9) is wide open and, along with the lateral panels (8) funnels the snow into the bag.

This process creates a build-up of pressure in the bag. The temperature then rises, relative to the speed of the avalanche. The pressure in the bag and in the opening is determined by the density of the net's toils. A large portion of the avalanche's energy is converted into heat by the mass of snow; the compact air goes through the net toils and

some of the snow follows. In this way, the ice crystals melt, even before they go through the toils, and change into water drops behind the toils, where there is a low pressure behind the sack, which quickly freezes them again. The water drops then change into fuzzy snow crystals that accumulate behind the APS and form a big icy mass. The rest of the avalanche stops in the net sack and piles up.

In this way, the APS dissipates a lot of the energy out of the avalanche. The remaining energy goes from the net sack into the leading strings (14, 15) in the bag and from there to the baserope (10), top rope (13) and the side-leading strings (12), then along the main strings (3 & 11) into the earth anchors (2), finally entering the ground. This happens while the avalanche is being stopped. The energy converts into heat, which warms up all the items above as well as the cold surroundings in the bag. Buy turning the energy into heat then most of the avalanches power is decreased and diffused, as it is stops.

When an avalanche has already been stopped in this way, there is the possibility of putting up an emergency APS that is fastened to the fastener that already exists. In this way, a new APS can be created on top of the existing avalanche.

The invention as it has been described here is not limited in its use to the method described here but can be implemented in many ways. For example; the plates can be taken out so that only the main strings are left between the net sack and the earth fasteners. It is also possible to configure the net sack in different ways. It is also possible that the APS can be used to protect cities and towns from violent storms.